RICE

Strategic Thinking for Complex Problem Solving

ENGI/LEAD 545 – Spring 2016

Tuesday 1-4pm, BRC 284

Objectives

Employers ask that you be excellent not just in your discipline but also in general problem solving.[1] How are you training yourself for that?

This course shows how to become a better strategic thinker, preparing you to solve complex, ill-defined, non-immediate (CIDNI) problems. It is project based, so you'll bring a problem that will become your project for the course and a case study for the group. You'll apply the concepts covered in the course to your problem, structuring its resolution as the course advances, and presenting your progress to the class for continuous feedback.

By working on case studies that are outside of your area of expertise, your will learn to move away from the technicalities of your discipline to focus on transferrable skills—logic, innovation, rigorous formulation of hypotheses, clarity of thinking, etc.—that allow you to develop an ability to think strategically. It is an objective of the course that you learn how to leverage these transferrable skills to approach problems in fields you know little about.

As such, the class composition is highly diverse, which has three major purposes:

- Facilitating system thinking by integrating problems in their larger contexts,
- Fostering the group's creativity by approaching problems from different points of view, and
- Emulating work in "real" organizations, where one must interact with people with different profiles.

In addition the course promotes using an analytical approach to problem solving, where evidence-based decision making is key.

Another objective of the course is for you to be able to explain your project to people who are not subject matter experts. This usually requires you to reinforce your understanding of the problem, gaining insight into its underlying structure.

A pivotal objective of the class is learning to leverage the collective skill set of the class and contributing to it. As such, a high involvement in the class dynamic is essential.

Finally, I don't want you to only learn *about* solving complex problems; rather, I want you to learn *how* to solve problems. So you'll learn by doing, applying the theory to your project and getting constructive (yet merciless!) criticism from your peers and yours truly. You'll probably end up working more in this class than in many others but look at the bright side: no exams!

Because you will spend a lot of energy on your project, you should choose it wisely. As such, the course requires instructor permission so that we get a chance to chat about your interests before it starts. A

[1] See, for instance, American Association of Universities (2013). It takes more than a major: Employer priorities for college learning and student success.

good project is one that you would spend a lot of time on anyway (for example, your thesis or dissertation) or that has a high pay off for you.

Instructor

Arnaud Chevallier, PhD
Associate Vice Provost
Rice University
6500 Main Street, MS-10, Houston, TX 77005
Office: (713) 348-4025
E-mail: chevallier@rice.edu
Office location: BRC 1021

Learning outcomes

By the end of the course, students will be able to:

1. **Frame the problem.** You will learn how to single out *the* real problem in a given situation, ensuring you aren't focusing on just a symptom or a less critical problem. You will also learn to identify key stakeholders and decision makers, project parameters, and elements out of scope. Finally, you will learn to summarize this information in a *WHAT* card.
2. **Diagnose the problem.** You will learn how to identify the root causes of the problem by building a diagnostic issue map. You will learn how to structure the map, associate hypotheses which each branch, design the analysis to test the hypotheses, identify the data needed to fuel the analysis, gather that data, test the hypotheses, and conclude. You will also learn how to structure your thinking in mutually exclusive and collectively exhaustive (MECE) components and rank the comparative insightfulness of competing frameworks.
3. **Identify solutions.** You will learn how to transition from the diagnostic to the active search for a solution by building a solution issue map. You will learn how to structure the solution map—understanding key similarities and differences with diagnostic issue maps—develop hypotheses, design the analysis to test them, and test them. You will also learn about decision making: how to pick the best solution, using decision matrices or other decision-making tools.
4. **Execute the solution.** You will learn how to use logic to communicate better—through a PowerPoint/Keynote presentation. Time permitting, we will also talk about how to use the other two components of Aristotelian persuasion (reputation and emotions), basic concepts of project management and team leadership as well as the continuous evaluation of the solution's performance once implemented.

Key characteristics

You will spend a lot of time on your project, so choose one that has a lot of value to you. A popular choice with previous students is to work on your thesis or final project.

Each session is a mix of theory and case studies, with an emphasis on the latter. You will integrate the theory in your project and present it periodically to the class for discussion.

Class participation is key, as reflected in the grading structure. You are all expected to contribute to discussions and help your classmates improve their projects—especially those in disciplines different than your own. A significant part of the grade depends on how much you help others.

The reading material is due *before* the corresponding lecture. We'll use the 'Strategic Thinking for Complex Problem Solving' manuscript (available on OwlSpace) and other resources. To help you extract the relevant 'so what?' for you, at the beginning of each class, you will hand in a one-page summary of the reading addressing: -1- Your main take away and -2- Your reflection on how are you going to modify your current practice to include what you've learned. This counts as part of the 'participation in class' grade.

We'll spend most time in class reviewing the progress that you are making. We'll do so either altogether or in smaller groups. So your classmates will become a pivotal driver of your success (and vice versa).

Please seek the input of your classmates. Do it often and do it with different classmates.

Please realize that your ability to get up to speed on a colleague's project—including one in which you know nothing about—is an essential leadership skill in the work place. So by helping your classmates with their projects, you are developing this fundamental skill. You are also fishing for new ideas: after each interaction, ask yourself how what you discussed might be applicable to your problem.

When handing in a deliverable, please submit a printout in class at the beginning of the session in which it is due and upload as a PDF in OwlSpace.

At least five students must be enrolled for the course to be offered. The course has no prerequisites and no exams. It's worth three semester hours.

Course calendar

	Date	Topic	Reading	Deliverable
1	1/12	Course overview Develop the project charter	Syllabus	
2	1/19	Frame the diagnostic problem	Chevallier: Chapter 1, 2 (Savransky 2002) chapter 1	Take away from reading
3	1/26	Develop a diagnostic issue map	Chevallier: Chapter 3 (Ness 2012)	Take away from reading *WHAT* card
4	2/2	Develop a diagnostic issue map	(Platt 1964) (Fisk 1972)	Take away from reading *WHY* card
5	2/9	Design a diagnostic analysis Conduct a diagnostic analysis	Chevallier: Chapter 4 (Twardy 2010)	Take away from reading *WHY* issue map

	Date	Topic	Reading	Deliverable
6	2/16	Conduct a diagnostic analysis	(Nickerson 1998) (Klayman and Ha 1987)	Take away from reading
7	2/23	Prepare a report for diagnostic analysis	Chevallier: Chapter 7 (Garner and Alley 2013)	Take away from reading
	3/1	Spring break – no class		
8	3/8	Present your report of diagnostic analysis	Chevallier: Chapter 5 (van Andel 1994)	Take away from reading Report of diagnostic analysis
9	3/15	Frame the solution problem	Chevallier: Chapter 6 (Fischhoff and Chauvin 2011)	Take away from reading
10	3/22	Develop a solution issue map	Chevallier: Chapter 8 (Axelrod 1984) Chapter 1 & 2	Take away from reading *HOW* card
11	3/29	Design a solution analysis	(Tversky and Kahneman 1974)	Take away from reading
12	4/5	Conduct the solution analysis	(Boucher, Barnett et al. 2015)	Take away from reading *HOW* issue map
13	4/12	Conduct the solution analysis	Chevallier: Chapter 9	Take away from reading
14	4/19	Present your report for solution analysis		Report of solution analysis

Additional reading

(Singer, Nielsen et al. 2012); (Polya 2008); (Minto 2009); Powerful-problem-solving.com;

Timvangelder.com; austhink.com; (Jones 1998); (Higgins 1994); (Ohmae 1982); (De Bono 1992); (Zelazny 2004); (Zelazny 1996); http://www.vangeldermonk.com/improvingreasoning.html

Course grading

	Value towards final grade
Class participation, including contributions to help others and comments on reading assignments	35%
WHAT card	5%
WHY card	5%
Diagnostic issue map	10%
Report of diagnostic analysis	10%
HOW card	5%

Solution issue map	10%
Solution hypotheses, analysis, and conclusions	10%
Final presentation and implementation plan	10%
Total	**100%**

No final exams.

I'll use a numeric scale during the semester before converting to a letter scale using the following correspondance:

Grade	Minimum percent
A	90
B	80
C	70
D	60
F	50

Assignments turned in late receive a 1% penalty per late day.

Academic honor code

Students are responsible for maintaining the integrity of academic work at Rice. All students must comply with the honor code and state so on each deliverable they hand in.

You can learn more about the Honor System at http://honor.rice.edu/

Disabilities

Any student with a documented disability needing academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All discussions will remain confidential. Students with disabilities will need to also contact Disability Support Services on the first floor of Allen Center (x5841 / adarice@rice.edu).

Others

Bring your laptop or tablet to class as it is easier to draw issue maps on those. If this is not possible, bring your latest progress on a USB key and arrange with a classmate to be able to project from their computer.

Consider acquiring a mapping software to develop issue maps. A review of common packages is available here.

This syllabus reflects as closely as possible the course as it unfolds over each session. However deliverables might change. Therefore don't trust it blindly for due dates and lecture plans. Instead, ensure that you comply with assignments discussed in class. If you miss a class, it is your responsibility

to check on assignments due and hand them in time.

You are expected to come to class and participate actively. If you can't make it to a session, please inform me ahead of time. If you miss a session, ensure that you catch up on the material covered—and the assignments—on time.

The class models typical interactions in the workplace. Therefore please display a professional attitude; in particular be proactive and responsive.

Office hours

Thursdays 1 to 2pm in BRC 1021 or by appointment (email me).

Bibliography

American Association of Universities (2013). It takes more than a major: Employer priorities for college learning and student success.

Axelrod, R. M. (1984). The evolution of cooperation, Basic books.

Boucher, S., A. Barnett and N. Thomason (2015). Improving your reasoning, Melbourne Critical Thinking Project.

De Bono, E. (1992). Serious creativity: Using the power of lateral thinking to create new ideas. New York, Harper Business.

Fischhoff, B. and C. Chauvin (2011). Collaboration. Intelligence analysis: Behavioral and social scientific foundations, National Academies Press.

Fisk, C. E. (1972). "The Sino-Soviet border dispute: A comparison of the conventional and Bayesian methods for intelligence warning." Studies in Intelligence 16(2): 53-62.

Garner, J. and M. Alley (2013). "How the design of presentation slides affects audience comprehension: A case for the assertion–evidence approach." International Journal of Engineering Education 29(6): 1564-1579.

Higgins, J. M. (1994). 101 creative problem solving techniques: The handbook of new ideas for business, New Management Publishing Company Florida.

Jones, M. D. (1998). The thinker's toolkit: 14 powerful techniques for problem solving, Random House Digital, Inc.

Kahneman, D., D. Lovallo and O. Sibony (2011). "Before you make that big decision." Harvard business review 89(6): 50-60.

Klayman, J. and Y.-W. Ha (1987). "Confirmation, disconfirmation, and information in hypothesis testing." Psychological review 94(2): 211.

Minto, B. (2009). The pyramid principle: logic in writing and thinking, Pearson Education.

Ness, R. B. (2012). "Tools for innovative thinking in epidemiology." American journal of epidemiology 175(8): 733-738.

Nickerson, R. S. (1998). "Confirmation bias: a ubiquitous phenomenon in many guises." Review of

General Psychology 2(2): 175.

Ohmae, K. (1982). The mind of the strategist, McGraw-Hill.

Oreskes, N., K. Shrader-Frechette and K. Belitz (1994). "Verification, validation, and confirmation of numerical models in the earth sciences." Science 263(5147): 641-646.

Platt, J. R. (1964). "Strong inference." science 146(3642): 347-353.

Polya, G. (2008). How to solve it: A new aspect of mathematical method, Princeton University Press.

Savransky, S. D. (2002). Engineering of creativity: Introduction to TRIZ methodology of inventive problem solving, CRC Press.

Singer, S. R., N. R. Nielsen and H. A. Schweingruber (2012). Discipline-based education research: Understanding and improving learning in undergraduate science and engineering, National Academies Press.

Tversky, A. and D. Kahneman (1974). "Judgment under uncertainty: Heuristics and biases." Science 185(4157): 1124-1131.

Twardy, C. (2010). "Argument maps improve critical thinking." Teaching Philosophy 27(2): 95-116.

van Andel, P. (1994). "Anatomy of the unsought finding. serendipity: Orgin, history, domains, traditions, appearances, patterns and programmability." The British Journal for the Philosophy of Science 45(2): 631-648.

Zelazny, G. (1996). Say it with charts, McGraw-Hill.

Zelazny, G. (2004). Say it with Presentations, Tata McGraw-Hill Education.

Additional reading:

(Oreskes, Shrader-Frechette et al. 1994)

(Kahneman, Lovallo et al. 2011)